

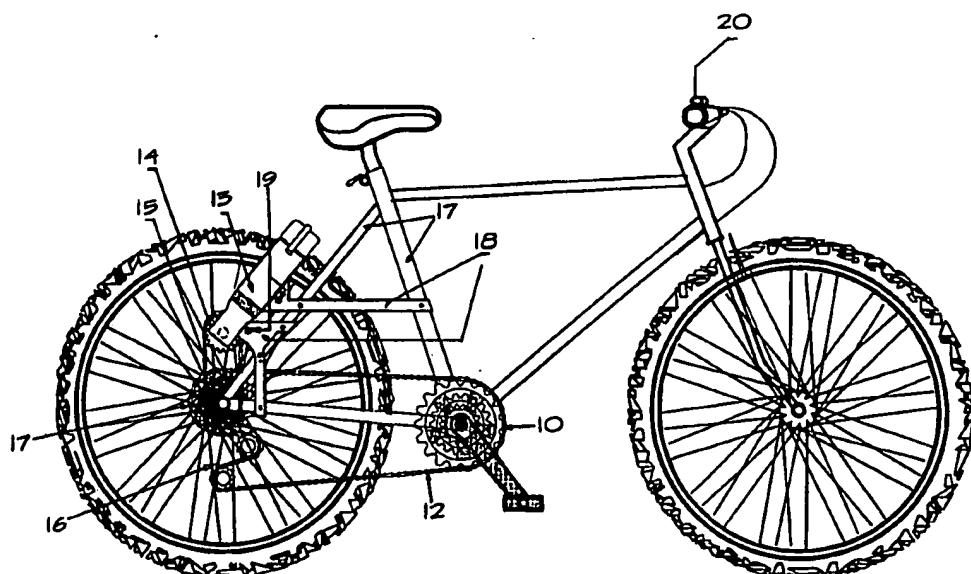


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(54) Title: AUXILIARY POWER ATTACHMENT FOR PEDAL CYCLES



(57) Abstract

A bicycle is disclosed which can be powered either by the pedals, through a front chain-wheel (10), a primary chain (12) and a rear derailleur sprocket block (11) or by an electric motor (13) through a motorised chain-wheel (14), a secondary chain (15) and an auxiliary sprocket (21). A derailleur chain thrower (16) is provided to throw the chain (12) from one sprocket to another in the usual way. The auxiliary sprocket (21) and the sprocket block (11) are mounted on the hub (23) of the bicycle's rear wheel on independent one-way clutch, ratchet or free-wheeling mechanisms (37, 40). In this way the primary (12) and secondary (15) chain may effectively operate independently of one another. The bicycle power attachment may be fitted to existing and production bicycles with a minimum of modification.

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DescriptionAuxiliary Power Attachment for Pedal CyclesTechnical Field

This invention relates to a pedal cycle having an auxiliary power attachment and also to the transmission system for such a cycle.

5 Background Art

Many attempts have in the past been made to provide pedal cycles, in particular bicycles, with auxiliary power attachments. These attempts fall largely into two categories: power attachments which are intended to be fitted to any type of pedal cycle and which deliver motive power 10 to the drive wheel of the cycle through a friction drive acting on the cycle tyre; and purpose-built cycles in which auxiliary motive power is commonly delivered through an auxiliary sprocket and chain drive. An example of a power attachment which belongs to the first of the above categories is disclosed in US patent No. 3 961 678. This document 15 describes an auxiliary power attachment which possesses a drive roller, the roller being brought into fractional contact with the circumferences of the cycle's tyre when auxiliary power is applied.

20 This type of power attachment has a number of disadvantages. The first is that the bicycle tyre and or the drive roller will tend to wear. this wear reduces the normal force with which the drive roller is pressed against the cycle tyre which in turn reduces the fractional force which the drive roller is capable of exerting on the cycle tyre. Slippage between the drive roller and the cycle tyre may occur, 25 necessitating continual re-adjustment of the drive mechanism to take the wear of the roller and tyre into account. Wear of the cycle's tyre through contact with the ground will have a similar effect.

30 A second disadvantage which this type of power attachment possesses is that the transmission from drive roller to cycle tyre is relative inefficient. Because the drive roller is pressed against the cycle tyre in order to achieve sufficient fractional contact, the portion of the tyre in contact with the roller is to some degree compressed. As the tyre 35 rotates, energy is dissipated in the continual compression of successive portion of the tyre and this creates a drag comparable in magnitude with the drag occasioned by contact of the tyre with the ground.

The types of purpose-built powered pedal cycles which have hitherto been proposed are exemplified by US patents nos. 4 410 060 and 4 541 500. The first of these documents illustrates a bicycle which possesses a standard sprocket and chain drive from the pedals to the rear wheel on the right hand side of the cycle. A battery operated electric motor is provided which, through reduction gearing, also drives the rear wheel. The last gear in the reduction gearing chain is attached to the left hand side of the rear wheel hub. Because the drive mechanism of this bicycle are attached to opposite sides of the rear wheel hub, the bicycle requires a purpose-built rear wheel and also reduction gearing chain.

The second of the above mentioned US Patents relating to the purpose-built cycles, US patent No. 4 541 500, discloses a bicycle in which motive power from the pedals and from an auxiliary electromotor is delivered to the same side of the rear wheel (the right hand side) to the rear wheel boss. Two transmission systems are disclosed in this patent: one uses a single chain which meshes both with the pedal-driven front chain-wheel and with a pinion which is driven by the electromotor; the other uses two chains, one meshing with the front chain wheel and the other with the electromotor pinion. In both cases however, the chain wheels are mounted on the rear wheel boss and made as one unit. There is also a multistage compact planetary gear provided on the rear wheel boss, having four to five stages on which pedal drive and electro drive operate simultaneously. Description in claim one of this document starts from pedal drive "*including a first chain plate*" then names the chain "*which engages a chain*" and then arrives at "*that in turn engages and drives said rear wheel boss*". In the same fashion description of the electrodrive starts from the electromotor, moves to "*second chain plate which in turn drives said chain*" and finally "*which engages and drives said rear wheel boss*". Thus it is clear that the "*free-wheeling*" which is provided in first and second "*chain plate*" are those at the front chain drive (fig. 2 ref. 12 of that document) and pinion (ref 16 of same fig.) and not at rear wheel boss. This bicycle therefore requires a purpose-built front chain-wheel in addition to purpose-built rear boss, gearbox and motor reduction gearing etc.

US Patent no. 4 280 581 also discloses a bicycle in which two drives are transmitted by a single chain to the rear wheel of a bicycle. Again, two intermediate free-wheel mechanisms are provided, at the point at which primary and auxiliary power are applied to the chain.

UK patent no. 1 074 431 discloses a bicycle which includes a Sturmey-Archer type gear box hub. The gear box hub is provided with an extended threaded input drive sleeve on which sprockets are fixed. The sleeve in this invention is a part of the internal gear box and not of the body of the hub. The sprockets are provided with independent free-wheeling mechanisms which can overrun in the same sense. Again, however this bicycle requires a purpose-built rear wheel (with a hub gear box), with an extended input sleeve to take the two free-wheeling.

10 **Disclosure of the invention**

The object of the present invention is to provide a transmission system for a pedal cycle which will allow the simultaneous or independent use of pedal power and auxiliary power, while requiring modification only of the rear sprocket arrangement of a standard pedal cycle.

Accordingly, this invention provides a transmission system for attachment to the right hand side of a pedal cycle's drive wheel hub, the transmission system comprising a primary sprocket as any known conventional kind provided in bicycles with multiple gear including a derailleur system and an auxiliary sprocket, pulley or other driven wheel having a one-way clutch or ratchet mechanism including an internally threaded part which is adapted to be threaded onto complementary thread on the existing wheel hub and means for attaching the primary sprocket, to the said auxiliary sprocket, pulley or other driven wheel to form a transmission assembly, being adapted to be threaded on to the complementary thread to allow independent overrunning of the first and second mechanisms in the same sense.

30 The primary sprocket will normally be driven through a primary chain and a chain-wheel by the pedals, the auxiliary sprocket, pulley or other driven wheel will similarly be driven through a secondary chain, belt or other driving mechanism by the auxiliary power attachment, for example an electric motor. Both the primary sprocket and the auxiliary sprocket, pulley or other driven wheel are attached to the same side of the wheel hub, the transmission system may be used with a standard cycle wheel that is adapted to take a drive only on its right hand side. Furthermore, since two mechanism are able to operate independent from one another, there is no requirement for the auxiliary power attachment or the pedal driven chain-wheel to be provided with an additional free-wheeling mechanism. The standard way in which transmission sprockets are attached to the cycle hub is by means of complementary threads of the hub which is an integral part of the hub casing.

Accordingly, the transmission system of this invention may be attached to the drive wheel of a standard cycle with standard wheel and standard hub with no further modification being required.

5 This invention is particularly advantageous for cycles which include a derailleur gear system. The modification of such cycles is particularly simple matter, as it would involve the removal of the existing derailleur sprocket block, attachment of the auxiliary sprocket, pulley or other driven wheel to the hub and reinstalling the derailleur sprocket block or one of lesser width to the external threads of the tube element that is attached to the said auxiliary sprocket. The limits of movement of the cycle's derailleur chain thrower would be adjusted

10 15 The standard way in which transmission sprockets are attached to the cycle hub is by means of complementary threads. Accordingly it is preferred that the auxiliary sprocket pulley or other driven wheel include an internal thread which is adapted to be threaded onto a complementary thread on the wheel hub so as to leave a portion of the internal thread exposed, and that the transmission system comprise means for attaching the primary sprocket to the exposed portion of the internal thread of the auxiliary sprocket, pulley or other driven wheel.

20 25 The said primary sprocket may be conveniently attached by means of an externally threaded tube which is adapted to be threaded into the exposed portion of the internal thread of the auxiliary sprocket, pulley or other driven wheel and on to which the primary sprocket may be threaded

30 It is preferred that transmission system include a threaded spacer, such as a washer or ring, which is adapted to be threaded onto the tube between the auxiliary sprocket, pulley or other driven wheel and the primary sprocket. The spacer has the effect of slightly spacing apart the auxiliary sprocket, pulley or other driven wheel and the primary sprocket thereby reducing the likelihood of the two drive chains or mechanisms interfering with one another.

35 40 This invention also provides an auxiliary power attachment for a pedal cycle comprising a motor, a transmission system according to the invention, a chain, belt or other driving mechanism to couple the motor to the auxiliary sprocket, pulley or other mechanism of the transmission system and means for mounting the motor on the pedal cycle.

45 It is preferred that the means for mounting the motor comprise at least one fixing arm adapted to be affixed to a plurality of cycle frame sizes

and configurations at the same right hand side of the rear fork.

5 The invention also provides a pedal cycle having mounted thereon a transmission system and/or an auxiliary power attachment according to the invention.

10 It is preferred that the motor, chain, belt or other driving mechanism and auxiliary sprocket, pulley or other driven wheel to be mounted in line. Other variations are also possible, as displayed on figure 4.

15 The motor includes an internal clutch (not shown) and a detachable NiCad or similar modern type battery. For convenience of control, the cycle include a manual control to regulate the motor, the manual control preferably being attached to the cycle's handlebars.

15

Description of Drawings

figure 1 is a side view of a bicycle including an auxiliary power attachment according to the invention;

20 figure 2 is a part sectional rear view of the rear wheel of a bicycle together with an auxiliary power attachment according to the invention;

figure 3 is an exploded sectional view of the auxiliary power attachment illustrated in figure 2;

25 figure 4 is an alternative exploded sectional view of the auxiliary power attachment.

30 Figure 1 illustrates a bicycle which may be powered either by the rider through a front chain-wheel (10), a primary chain (12) and a rear primary sprocket (11) or by an electric motor (13) through a motorised chain-wheel (14), a secondary chain (15) and an auxiliary sprocket (not shown). The primary chain (12) passes through a rear derailleur chain thrower (16) by means of which it may be thrown between adjacent sprockets of a 35 derailleur sprocket block (11) in the usual way. A front chain thrower is also provided, but is not illustrated in the figure.

35

The electric motor (13) is attached to the bicycle frame (17) by fixing arms (18) to the bicycle frame (17). It is preferred that the fixing arms (18) be provided with a plurality of pre-drilled holes or slots which enable their attachment to a variety of different frame sizes and configurations. The motor (13) is bolted to the fixing arms (18) by a pair of bolts (19).

40 An electric switch (20) is attached to the bicycle's left handlebar allowing the rider to command the electric motor (13). A secondary safety switch,

to cut off the motor (13) when brakes are applied, also provided.

Figure 2 illustrates in more detail the way in which the electric motor (13) is coupled to the bicycle's rear wheel (22). As can be seen, the motorised chain-wheel (14) is coupled to an auxiliary sprocket (21) mounted on the rear wheel hub (23). The coupling is effected by the secondary chain (15). The primary chain from the front chain-wheel is not shown but would mesh with one of the five sprockets on the rear sprocket block (11). The sprocket block (11) and the auxiliary sprocket (21) are mounted on the rear wheel hub, one directly and the other indirectly (23) each with their own individual one-way clutches or free-wheeling mechanism accordingly.

The electric motor (13) consists of a housing (24) having a lid (25) within which the motor armature is retained. When the housing lid (25) is closed, the motor is protected from external weather conditions. The lid may be opened to allow the insertion of a NiCad or similar battery (26), which when so inserted again closes the housing (24) to external weather conditions. The battery (26) is retained in place by means of a spring clip (27).

As can more clearly be seen from figure 3 the shaft (28) of the electric motor (13) drives a lower shaft portion (29) which is mounted in a lower housing portion (30) by means of bearing racers (31). This lower shaft portion (29) carries a bevel gear (32) at its lower end which meshes with a second bevel gear (33) perpendicular thereto. This second bevel gear (33) is attached to a spindle which also carries the motorised chain-wheel (14). The spindle is retained in the lower housing portion (30) by means of bearing racers (34). The motor sprocket (14) is positioned in line with the auxiliary sprocket (21) on the bicycles rear hub (23).

Figure 3 also illustrates the attachment of the auxiliary sprocket (21) and sprocket block (11) to the bicycle's rear hub (23). In accordance with standard practice, the bicycles rear hub (23) is provided with a threaded extension (35). The auxiliary sprocket (21) is provided with a complementary internal thread (36). The auxiliary sprocket (21) may therefore be threaded onto the hub (35) and when this is done, a portion of the internal thread (36) remains exposed. The auxiliary sprocket (21) is provided with a clutch mechanism (37).

Once the auxiliary sprocket (21) is attached to the hub (35), a short thread still tube (38) is threaded into the exposed portion of the auxiliary sprocket's internal thread (36). To lock this tube in position and also to provide a spacer between the auxiliary sprocket (21) and the sprocket

block (21) and the sprocket block (11), a threaded washer or ring (39) is screwed on the threaded tube (38) and tightly abutted against the auxiliary sprocket (21). Subsequently, the sprocket block (11), which has its own internal free-wheeling mechanism (40), is threaded onto the steel tube (38).

According to the invention, both the auxiliary sprocket (21) and the sprocket block (11) are mounted directly and indirectly on the hub of the bicycle's rear wheel having their own independent mechanism (37, 40).

Thus the rear wheel hub (23) may overrun in the forward sense with respect to either or both of the auxiliary sprocket (21) and the primary sprocket block (11). The primary (12) and secondary (15) chains therefore effectively operate independently of one another.

If it is envisaged that the motor will be used in some but not all journeys, the entire motor, rather than merely the battery (26), may be made detachable from the fixing arms (18). Either the lower housing portion (30) is left in place, together with the secondary chain (15) or the secondary chain (15) may be split and removed, allowing removal of the lower housing portion (30).

It will of course be understood that the above description has been given purely by way of example and that modification of detail may be made without departing from the space of the invention. For example, the auxiliary sprocket and the threaded tube may be manufactured as an integral unit. similarly such a unit may also include the primary sprocket.

CLAIMS

1. A transmission system for attachment to one side of a pedal cycle's drive wheel hub, The transmission system comprising a primary sprocket block, having a free-wheeling mechanism, a sprocket block in similar to the said primary block be detached from the complementary threads of the rear wheel hub if existed, an auxiliary sprocket, pulley or other driven wheel having a one-way clutch mechanism including an internally threaded part is adapted to be threaded on to the complementary threads of the wheel hub, and means for attaching the internally threaded part of the said primary sprocket or similar to the auxiliary sprocket, pulley or other driven wheel on the said one side of the wheel hub to form a transmission assembly, the transmission assembly allowing independent overrunning of the first and second sprockets in the same sense.
- 15 2. A transmission system according to claim 1 in which the primary sprocket is a sprocket of a derailleuer sprocket block.
3. A transmission system according to claim 1 or claim 2 in which the internally threaded part of the said one sprocket, pulley or other driven wheel is adapted to be threaded onto the complementary thread so as to leave a portion of the internal thread exposed, and which comprises means for attaching the said other sprocket, pulley or other driven wheel to the exposed portion of the internally threaded part of the said one sprocket, pulley or other driven wheel.
- 20 4. A transmission system according to claim 1 or claim 3 in which the means for attaching the said other sprocket includes an externally threaded tube which is adapted to be threaded into the exposed portion of the internal thread of the auxiliary sprocket, pulley or other driven wheel and onto which the primary sprocket may be threaded.
- 25 5. A transmission system according to claim 1 claim 3 and claim 4, wherein auxiliary sprocket and threaded tube are made as one.
- 30 6. A transmission system according to preceding claims including a threaded washer or threaded ring which is adapted to be threaded onto the tube between the auxiliary sprocket, pulley or other driven wheel and the primary sprocket.
- 35 7. A transmission system as claimed in preceding claims wherein all parts are pre-assembled as one.

8. An auxiliary power attachment for a pedal cycle comprising a motor, including an internal clutch, a transmission system according to any preceding claim, a chain, belt or other driving mechanism to couple the motor to the auxiliary sprocket, pulley or other driven wheel of the transmission system and means for mounting the motor on the pedal cycle.
- 5
9. An auxiliary power attachment according to claim 8 in which the means for mounting the motor comprises at least one fixing arm adapted to be fixed to a plurality of cycle frame sizes and configurations.
- 10
10. A pedal cycle having mounted thereon a transmission system according to any one of claims 1-7.
- 15
11. A pedal cycle having mounted thereon an auxiliary power attachment according to claim 8 or to claim 9.
12. A cycle according to claim 11 in which the motor, chain, belt or other driving mechanism and auxiliary sprocket, pulley or other driven wheel are mounted in line at the said side of the wheel.
- 20
13. A cycle according to claim 11 or claim 12 in which the motor is an electric motor including a detachable NiCad or similar modern battery.
- 25
14. A cycle according to any one of claims 11-13 including a remote manual switch commanding the motor, attached to the handlebars of the cycle.
- 30
15. A transmission system for a pedal cycle substantially as described herein with reference to the accompanying drawings.
16. An auxiliary power attachment for a pedal cycle substantially as described herein with reference to the accompanying drawings.
- 35
17. A bicycle substantially as described herein with reference to the accompanying drawings.

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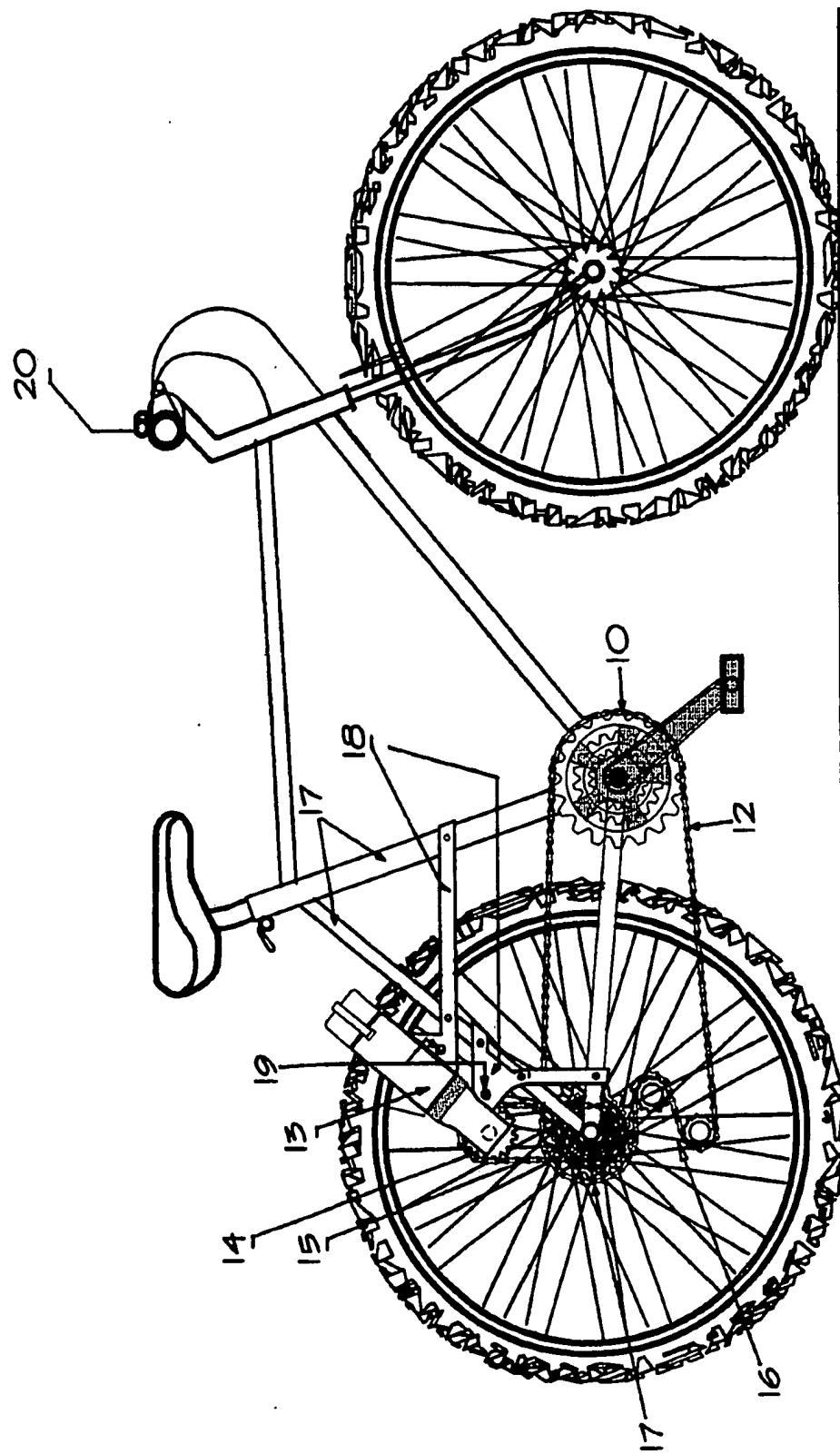


Figure 1

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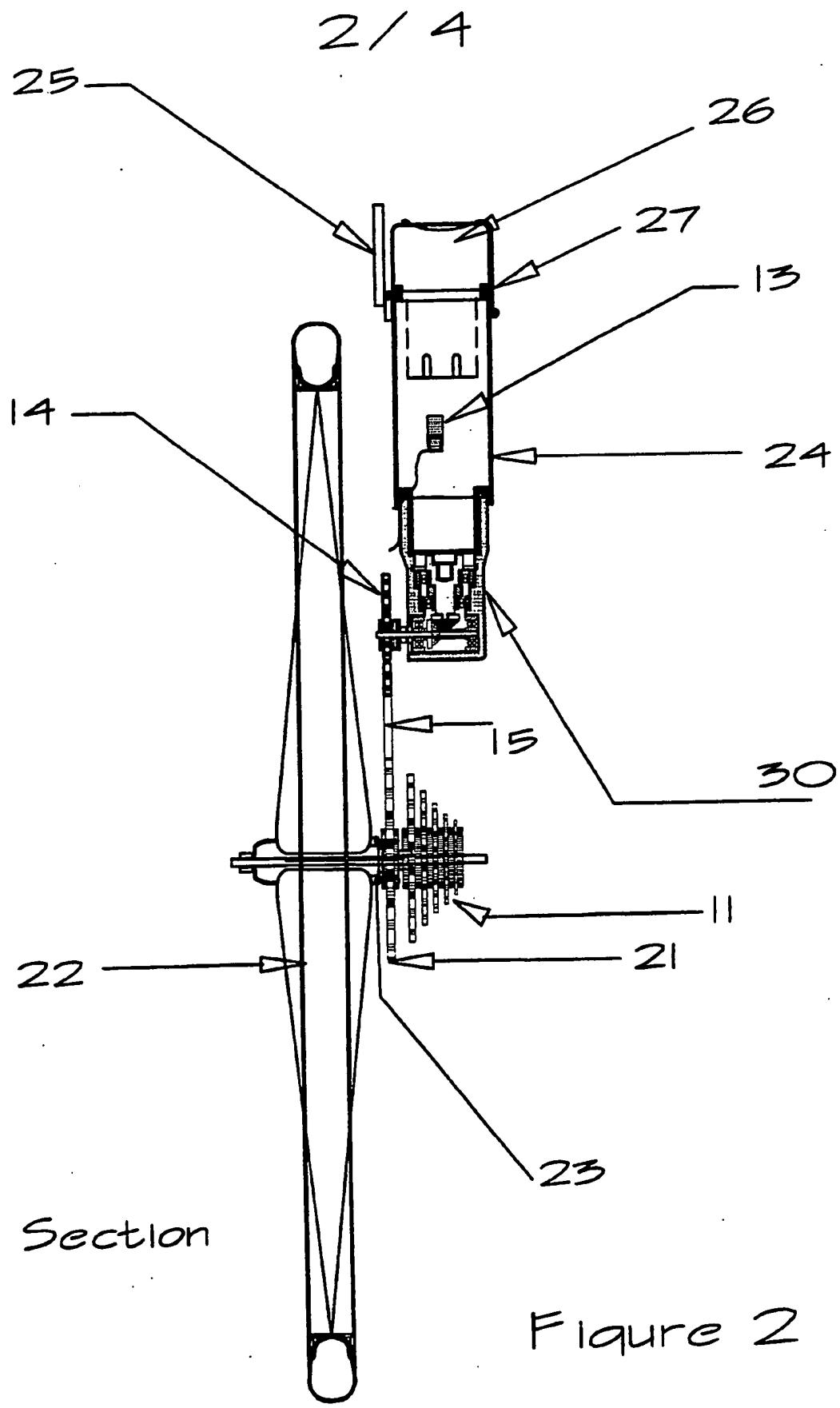


Figure 2

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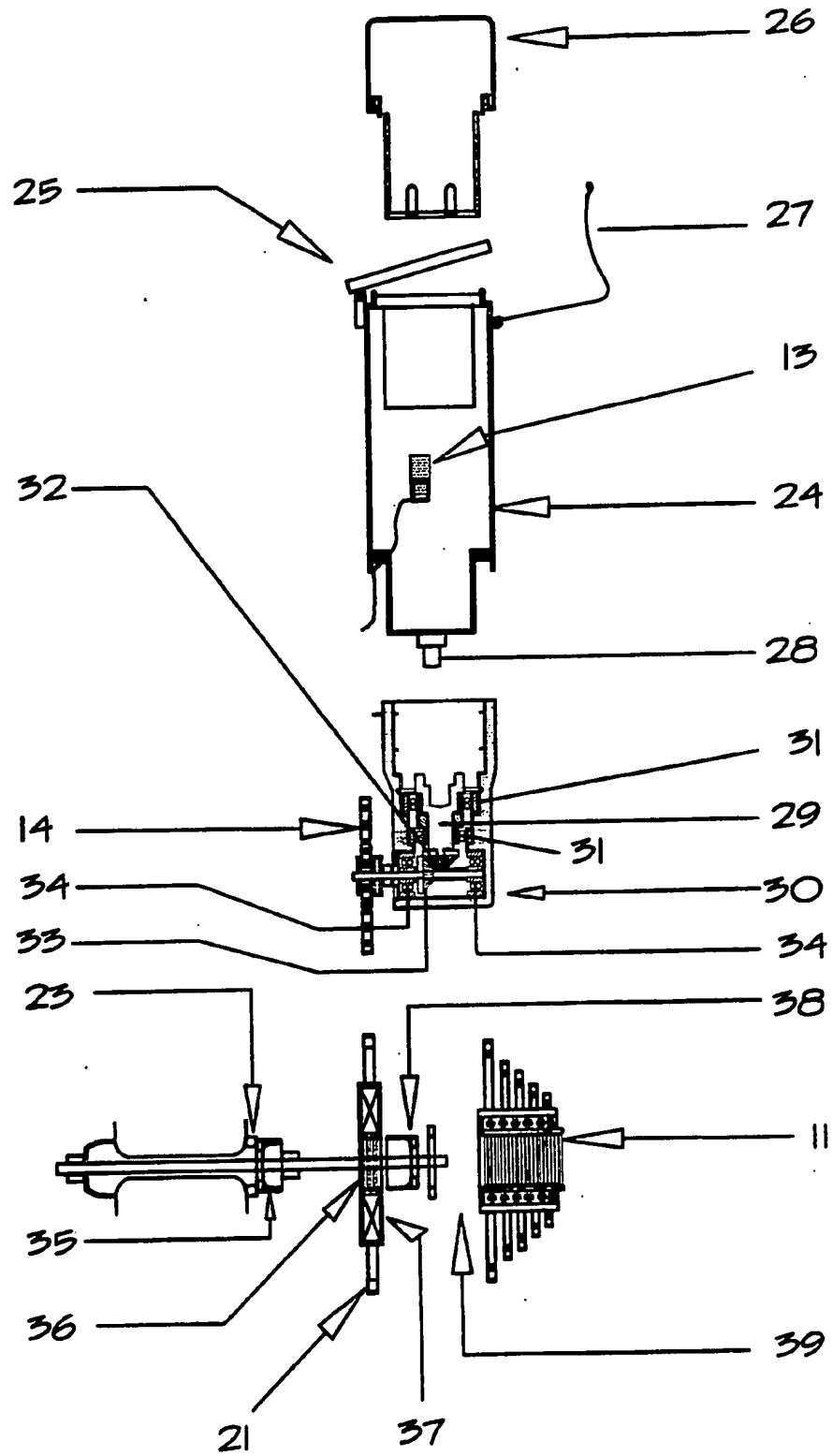


Figure 3
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Section

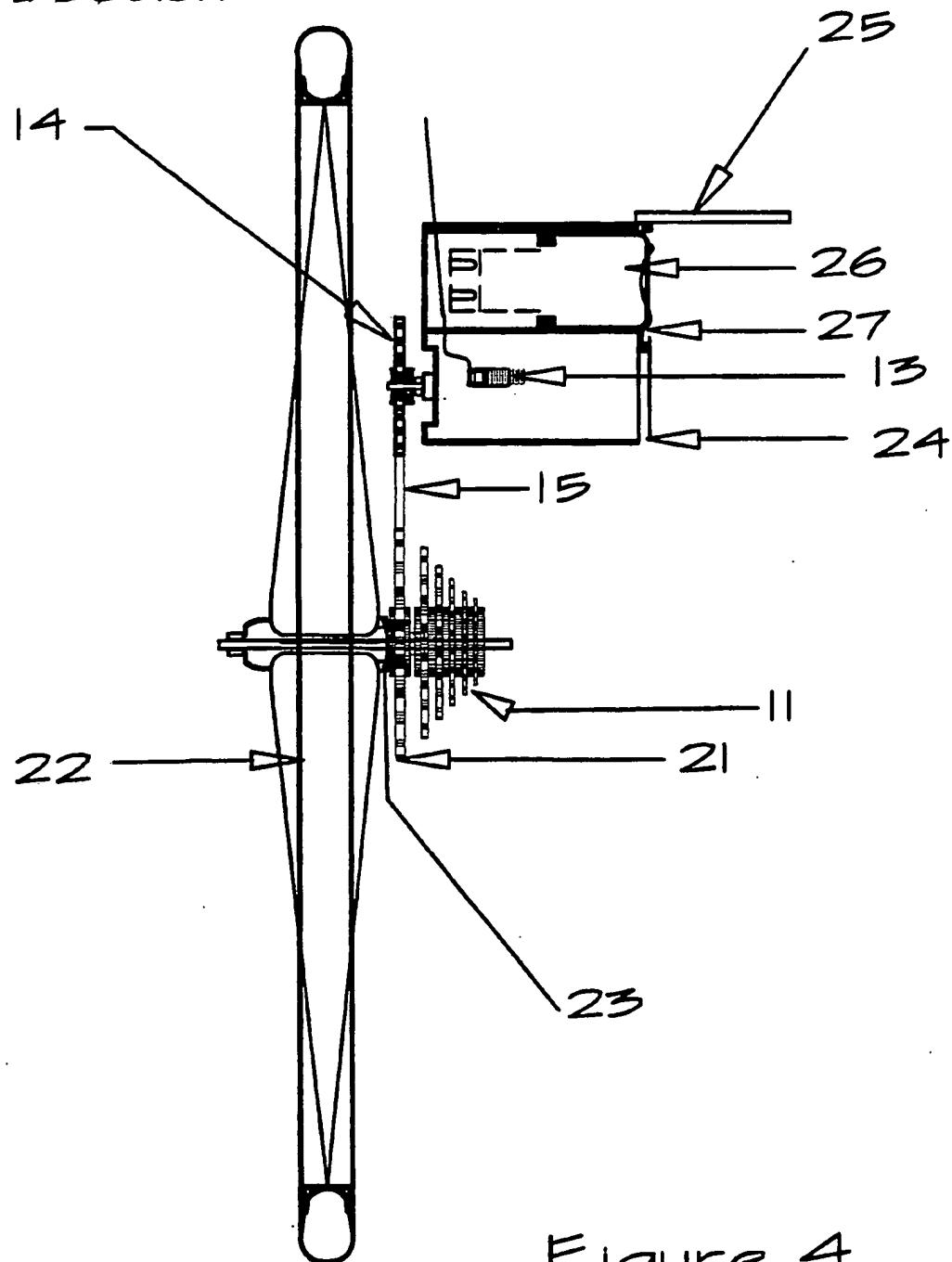


Figure 4

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INTERNATIONAL SEARCH REPORT

PCT/GB 92/02336

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC
 Int.Cl. 5 B62M23/02; B62M9/10; B60B27/02

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

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Documentation Searched other than Minimum Documentation
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III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

| Category ¹⁰ | Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹² | Relevant to Claim No. ¹³ |
|------------------------|--|-------------------------------------|
| A | US,A,3 900 088 (OZAKI) 19 August 1975 see the whole document ---- | 1 |
| A | GB,A,515 766 (CAMILLIS) 11 January 1940 see the whole document ---- | 1 |
| A | FR,A,2 411 302 (AUXILEC) 6 July 1979 see the whole document ---- | 8,11,13 |
| A | FR,A,868 254 (RANC) 26 December 1941 see the whole document ----- | 8 |

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IV. CERTIFICATION

Date of the Actual Completion of the International Search

23 MARCH 1993

Date of Mailing of this International Search Report

2. 3. 93

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

DENICOLAI G.

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.

GB 9202336
SA 67846

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
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| US-A-3900088 | 19-08-75 | JP-C- 1148000 JP-A- 48078633 JP-B- 57004558 | 26-05-83 22-10-73 26-01-82 |
| GB-A-515766 | | None | |
| FR-A-2411302 | 06-07-79 | None | |
| FR-A-868254 | | None | |

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